Characteristics and Outcomes in African American Patients With Decompensated Heart Failure

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Background: Outcomes in patients with chronic heart failure vary by race. Racial differences in the characteristics and outcomes of patients with acute decompensated heart failure (ADHF) have not been well characterized. Therefore, we assessed race-related differences in presentation, treatment, in-patient experiences, and short-term mortality due to ADHF before and after accounting for known covariates.

Methods: The Acute Decompensated Heart Failure National Registry database was analyzed to evaluate demographic and mortality differences in African American and white patients with ADHF entered into the database from its initiation in September 2001 to December 31, 2004. Stratified analyses by cause, age, left ventricular function, and history of heart failure subgroups were also conducted.

Results: A total of 105,872 episodes of ADHF occurred in white patients and 29,862 occurred in African American patients. African American patients with ADHF were younger than white patients (mean [SD] age, 63.5 [15.4] vs 72.5 [12.5] years) and had lower mean left ventricular ejection fractions. The prevalence of hypertension, diabetes mellitus, and obesity was higher in African American patients. African American race was associated with lower in-hospital mortality after adjustment for known predictors (2.1% vs 4.5%; adjusted odds ratio [OR], 0.79; 95% confidence interval [CI], 0.72-0.87; P < .001). This association persisted for all age cohorts, was independent of the use of intravenous vasoactive drugs, and was especially present in African American patients in the nonischemic subgroup (adjusted OR, 0.74; 95% CI, 0.57-0.96) but not the ischemic subgroup (adjusted OR, 0.91; 95% CI, 0.76-1.09).

Conclusion: In ADHF, African American race is associated with lower in-hospital mortality compared with white race, despite certain indicators of increased disease severity.

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whether African American race was associated with adverse outcomes in the inpatient setting after adjusting for disease severity and associated comorbidities. Evidence-based medical therapy and inpatient care algorithms should be available to all patients hospitalized with ADHF. Thus, the inpatient mortality experience should be independent of issues related to the prescription of inpatient therapeutics. Therefore, the intent of this analysis was to assess race-related differences in presentation, treatment, inpatient experiences, and short-term mortality due to ADHF as a function of race before and after accounting for known covariates.

**METHODS**

**DESIGN AND GOALS OF ADHERE**

ADHERE is a national registry of patients with ADHF, with more than 200,000 discrete patient episodes of ADHF. The primary goals of the ADHERE registry are to describe the demographic and clinical characteristics of patients hospitalized with ADHF, characterize the initial evaluation and subsequent inpatient management, and identify trends in medical management over time. A scientific advisory committee participated in the design of ADHERE, oversees the ongoing conduct of the registry, and has full access to registry data.

**PARTICIPATION AND DATA COLLECTION IN ADHERE**

A total of 274 community, tertiary, and academic centers from all areas of the United States participated in this registry, and their demographics are representative of the nation’s hospitals as a whole. The design, methods, and patient characteristics in ADHERE have been previously described. Briefly, medical records were retrospectively reviewed at participating sites by the research coordinator, and data from consecutive eligible male and female patients 18 years or older at hospital admission were entered into the registry electronically. These data included demographic information, medical history, baseline clinical characteristics, initial evaluation, treatment received, procedures performed, hospital course, and patient disposition. Admission and/or medical staff recorded race and ethnicity, usually as the patient was registered. Patients were assigned to race and ethnicity categories using options defined by the registry protocol. Registry participation did not require any alteration of treatment or hospital care, and entry of data into the registry was not contingent on the use of any particular therapeutic agent or treatment regimen. All hospitals obtained institutional review board approval for participation. The data collection system was designed such that patient informed consent was not required. To preserve patient confidentiality, direct patient identifiers were not collected. Thus, registry entries reflect individual hospitalization events or patient episodes, not individual patients, and multiple hospitalizations of the same patient could have been entered into the registry as separate records. Patients were not followed up longitudinally, and postdischarge clinical outcomes are not available. The present analysis included patients entered into the database from its initiation in September 2001 to December 31, 2004.

**STATISTICAL ANALYSES**

The ADHERE database was used for this retrospective analysis. Only patient episodes that occurred in African American and white patients were included in this analysis. Univariate comparisons between groups were performed using the χ² test for categorical variables and analysis of variance for continuous variables. Two-sided P values were reported. In addition, mortality in the 2 racial groups was compared using logistic regression adjusted for mortality risk factors. Separate analyses for 3 specific subgroups were also conducted: ischemic origin, nonischemic origin, and new-onset heart failure. The subgroups were chosen based on their clinical relevance, the potential reflection of different pathophysiologic features by race, and whether the findings in the overall cohort were influenced by repetitive hospitalizations in individual patients because patients could have been entered into the ADHERE database more than once. The ischemic subgroup consisted of patients with an ischemic heart failure origin or another known origin that was not ischemic if a history of coronary artery disease (CAD) or a history of myocardial infarction (MI) was present. The nonischemic subgroup consisted of patients with a nonischemic heart failure origin and no history of CAD or MI. The denominator for the origin subgroups was based on patients with nonmissing origin. The final subgroup included those unique patients with no prior hospitalization for heart failure. The analyses were performed in the subset of patients with a first heart failure admission (ie, no prior heart failure) as a data quality check to assess the potential confounding of multiple readmissions of the same patients. We also included an analysis of patients with a heart failure history to evaluate whether differences in chronic heart failure management could have influenced inhospital outcome. The area under the receiver operating characteristic curve was used to assess the discrimination of the models. These analyses were performed using SAS statistical software, version 8.2 (SAS Institute Inc, Cary, North Carolina).

**MORTALITY RISK FACTORS**

A series of sequential multivariate analyses was conducted to assess the influence of relevant prognostic factors on the association between race and mortality. Because the number of collected characteristics was large and certain data for some patient episodes were missing, univariate analysis was used as a primary screening tool to identify key mortality predictors. We conducted sequential multivariate analyses, assessing age, sex, and clinical characteristics previously shown to be associated with mortality in the ADHERE data set (dyspnea at rest, blood urea nitrogen level, serum creatinine level, initial systolic blood pressure, initial diastolic blood pressure, initial pulse, and serum sodium level), long-term angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB) use, and β-blocker use. Patients with missing data for the covariates were excluded from the model. For all covariates, less than 3% of the data were missing.

**BASELINE CHARACTERISTICS**

The baseline characteristics of the African American (n=29,862) and white (n=105,872) patients are given in Table 1. Because of the many patient episodes contained in the database, some between-group differences are statistically significant, although the absolute differences are small. As seen in previous studies, African American patients admitted with heart failure were younger than white patients. Of those patient episodes with a heart failure origin identified (n=51,561), more...
than half of white patients had an ischemic origin, whereas only a third of African American patients had an ischemic origin. The ejection fraction was lower in African American patients, with 9% more African American patients having moderate to severe left ventricular impairment compared with white patients. African American patients were more likely to have coexisting diabetes mellitus and hypertension but less likely to have CAD or atrial fibrillation or to have experienced a stroke, transient ischemic attack, or MI. Obesity was much more common in African American patients. The mean initial systolic blood pressure and diastolic blood pressure were more than 10 points higher in African American patients, and African American patients were more often hypertensive (systolic blood pressure >140 mm Hg) on admission. Initial pulse was higher in African American patients, with a greater frequency of tachycardia (pulse >100/min) on presentation. Although the serum creatinine level was higher in African American patients compared with white patients, the blood urea nitrogen level was lower. White patients had slightly lower mean serum sodium concentrations and were more often hypotensive. More white patients had a prolonged QRS duration on electrocardiography (Table 1).

HEART FAILURE SEVERITY

Several variables associated with heart failure severity according to heart failure origin and the presence of CAD or prior MI were compared between groups. African American patients were younger and had a higher body mass index, less hypotenension, less hypotension, a greater frequency of renal dysfunction (serum creatinine >2.0 mg/dL; to convert to micromoles per liter, multiply by 88.4), a lower ejection fraction, and a higher pulse. African American patients with a nonischemic origin were also nearly 2 decades younger than white patients with a nonischemic origin and no CAD or MI. The magnitude of difference in mean ejection fraction and the frequency of renal dysfunction seemed to be greater between African American and white patients with a nonischemic origin, whereas the differences in these variables were smaller although still statistically significant between African American and white patients with an ischemic origin and CAD or MI. The characteristics of patients without a heart failure history were similar to those of the overall cohort, suggesting that multiple hospitalization episodes of the same patient did not substantially influence the findings.

MEDICATIONS

Long-term baseline oral therapy, discharge oral therapy, and intravenous medications used in the hospital are listed in Table 2. Long-term ACEI or ARB use before admission was higher in African American patients in the overall cohort (Figure). However, ACEI or ARB use did not differ by race in the subgroup of patients without a heart failure history. Long-term β-blocker use was lower in African American patients overall, regardless of heart failure history. β-Blockers were used more frequently in African American patients with a nonischemic origin, but the use did not differ by race in the ischemic subgroup. More African American patients overall received ACEI or ARB and β-blocker therapy at hospital discharge than did white patients (Figure). Peripheral vasodilators (hydralazine) were prescribed to African American patients more often than white patients at hospital admission and discharge (Table 2). The maximal penetration of combination hydralazine and isosorbide dinitrate was low (3.6% of African American patients and 2.4% of white patients). The use of combination hydralazine and isosor-
bide dinitrate was not expected to be substantial because the ADHERE data were collected before the publication of the African American Heart Failure Trial results in November 2004. Although the decision to prescribe evidence-based therapies may be influenced by left ventricular ejection fraction (LVEF) (the presence of systolic dysfunction vs preserved systolic function), the patterns of medication use among African American and white patients were similar regardless of LVEF.

During the hospitalization, white patients were more likely to receive intravenous medications, including inotropes, diuretics, and any intravenous vasoactive drug (Table 2). Interestingly, African American patients more often received intravenous nitroglycerin as a vasodilator, whereas white patients more often received nesiritide. In the nonischemic subset, no difference by race was found in the use of any inotrope or any intravenous diuretic. The use of any intravenous vasoactive drug in the nonischemic group was higher in African American compared with white patients. Nitroglycerin use was higher among African American patients, but no racial differences were detected in the use of nesiritide within this subgroup. These patterns were similar regardless of LVEF.

IN-HOSPITAL OUTCOMES
(UNADJUSTED ANALYSIS)

The unadjusted in-hospital outcomes for the aggregate of patient episodes are given in Table 3. Mortality was lower in African American patients in the overall cohort and regardless of ischemic or nonischemic origin. In-hospital mortality rates were highest for both racial groups within the ischemic subset. In the aggregate of patient episodes, African American patients had a higher frequency of intensive care unit (ICU) or coronary care unit admission but a shorter ICU and overall hospital length of stay. African American patients were more often asymptomatic at hospital discharge compared with white patients. In contrast to the findings of the overall cohort, slightly fewer African American patients in the ischemic cohort were asymptomatic at discharge. Outcomes for patients with new-onset heart failure were similar to those of the overall cohort.

MULTIVARIATE ANALYSIS

The results of the mortality multivariate analysis for all patient episodes and for the 3 subgroups are displayed in Table 4. For the aggregate of patient episodes, after multivariate adjustment, African American race was associated with a lower risk of in-hospital mortality compared with white race. Race was not associated with mortality in patients with ischemic origin and CAD or MI. For patient episodes with a nonischemic origin, the adjusted mortality in African American patients was lower than in white patients, consistent with the overall cohort. Because white patients were more likely than African American patients to receive any vasoactive agent in the overall cohort, we performed the mortality analysis in the subset of patients who did and did not receive intravenous vasoactive agents to evaluate whether the mortality difference between races could be attributed to vasoactive drug use. African American patients had a lower adjusted odds ratio (OR) for mortality, regardless of intravenous vasoactive drug use (OR adjusted for intravenous vasoactive drug use, 0.83; 95% confidence interval [CI], 0.73-0.94; P = .003; OR adjusted for no intravenous vasoactive drug use, 0.77; 95% CI, 0.67-0.89; P < .001). Thus, it does not seem that the observed mortality differences can be explained by greater vasoactive drug use among white patients.

We also evaluated the OR for mortality among several other subgroups, including age categories, patients...
patients were more likely to receive ACEIs or ARBs and white patients based on the presence of a lower ejection fraction. Heart failure severity seems to be worse in African American patients but statistical significance was not achieved. Another retrospective study compared African American and white patients with ADHF. The unadjusted and adjusted in-hospital mortality for African American patients with ADHF and without a history of ischemic heart disease was lower compared with white patients. These data potentially generate the hypothesis that African American patients with a nonischemic origin of left ventricular dysfunction and heart failure may exhibit pathophysiologic findings that differ from those of white patients.

**Table 3. Unadjusted Outcomes of Acute Decompensated Heart Failure by Race**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>African American Patients</th>
<th>White Patients</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patient episodes (n=29 862 African American and 105 872 white patients)</td>
<td>5480 (18.4)</td>
<td>18 560 (17.5)</td>
<td>.001</td>
</tr>
<tr>
<td>Admitted to ICU or CCU</td>
<td>2.2 (1.2-4.0)</td>
<td>2.5 (1.3-4.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ICU LOS, d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.1 (2.7-6.8)</td>
<td>4.4 (2.9-7.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Asymptomatic at discharge</td>
<td>13 123 (52.2) (n=25 135)</td>
<td>45 845 (50.7) (n=90 418)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>In-hospital death</td>
<td>618 (2.1)</td>
<td>4747 (4.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ischemic origin and CAD or MI (n=6037 African American and 31 652 white patients)</td>
<td>1197 (19.8)</td>
<td>6078 (19.2)</td>
<td>.26</td>
</tr>
<tr>
<td>ICU LOS, d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.3 (1.2-4.1)</td>
<td>2.5 (1.3-4.8)</td>
<td>.03</td>
</tr>
<tr>
<td>Hospital LOS, d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.3 (2.7-7.0)</td>
<td>4.5 (2.9-7.3)</td>
<td>.02</td>
</tr>
<tr>
<td>Asymptomatic at discharge</td>
<td>2545 (46.1) (n=5290)</td>
<td>13 726 (49.6) (n=27 671)</td>
<td>.05</td>
</tr>
<tr>
<td>In-hospital death</td>
<td>170 (2.8)</td>
<td>1550 (4.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Nonischemic origin and no CAD or MI (n=5105 African American and 8767 white patients)</td>
<td>955 (18.7)</td>
<td>1576 (18.0)</td>
<td>.28</td>
</tr>
<tr>
<td>ICU LOS, d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.3 (1.2-4.1)</td>
<td>2.3 (1.2-4.7)</td>
<td>.63</td>
</tr>
<tr>
<td>Hospital LOS, d&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.0 (2.6-6.5)</td>
<td>4.3 (2.8-7.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Asymptomatic at discharge</td>
<td>2293 (50.8) (n=4512)</td>
<td>3818 (49.3) (n=7749)</td>
<td>.10</td>
</tr>
<tr>
<td>In-hospital death</td>
<td>98 (1.9)</td>
<td>384 (4.4)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: CAD, coronary artery disease; CCU, coronary care unit; ICU, intensive care unit; LOS, length of stay; MI, myocardial infarction.
<sup>a</sup>Data are given as number (percentage) of each group (dichotomous variables) unless otherwise indicated.
<sup>b</sup>Data are given as median (25th-75th percentile) (continuous variables).

with a heart failure history, those with an LVEF of less than 40%, and those with an LVEF of 40% or higher to assess the consistency of the overall cohort results. The findings were remarkably consistent across these subgroups, with a lower adjusted OR for mortality among African American compared with white patients. Statistical significance was reached for all comparisons except for the age categories of younger than 45 years and 65 to 75 years after multivariate adjustment, where the point estimate suggested lower mortality for African American patients but statistical significance was not achieved.

**COMMENT**

To our knowledge, these data represent the largest and most comprehensive analysis to date describing racial differences in patients with ADHF. Compared with white patients with ADHF, African American patients with ADHF are younger, less likely to have documented evidence of ischemic heart disease, and more likely to have a documented history of hypertension, often as the sole potential contributor to left ventricular dysfunction. Disease severity seems to be worse in African American patients based on the presence of a lower ejection fraction and more patients with renal insufficiency. Inpatient therapy was largely similar, but African American patients were more likely to receive ACEIs or ARBs and white patients were more likely to receive β-blockers overall. The use of combined isosorbide dinitrate and hydralazine was negligible in these data that predate the African American Heart Failure Trial findings. However, greater use of this regimen should improve outcomes for African American patients with heart failure in the future. Outcomes data demonstrated that African American race was associated with shorter ICU and overall hospital length of stay and lower in-hospital mortality compared with white race.

Although some differences were observed in baseline characteristics between African American and white patients with ischemic heart disease and ADHF, the magnitude of these differences was not large. In contrast, the degree of difference in clinical characteristics seemed to be larger for African American and white patients with ADHF and without a history of ischemic heart disease was lower compared with white patients. These data potentially generate the hypothesis that African American patients with a nonischemic origin of left ventricular dysfunction and heart failure may exhibit pathophysiologic findings that differ from those of white patients.

In a retrospective study that examined the influence of race and sex on outcomes for hospitalized patients in New York State given a discharge diagnosis of heart failure, African American patients had a longer length of stay compared with white patients, a higher OR of readmission (adjusted OR, 1.30), and a lower in-hospital mortality (adjusted OR, 0.83) after adjusting for age, sex, comorbidities, and ischemic heart disease. Similarly, another retrospective study that used a nationwide health care quality database found that despite having a higher comorbidity score, African American patients had lower adjusted in-hospital mortality (adjusted OR, 0.63) but similar length of stay. Outcomes were adjusted for age, sex, comorbidity score, income, payer sta-
tus, hospital region, location or teaching status, and hospital size. A 10-year analysis of the Medicare database from 1990 to 2000 found that in-hospital mortality for heart failure was lower in African American patients compared with white patients in all age categories, although all patients were older than 65 years. The mortality difference persisted after accounting for age and sex, but individuals younger than 65 years were not represented. An analysis of the Veterans Affairs database, which included men only, found lower unadjusted in-hospital mortality in African American patients compared with white patients admitted for heart failure; this finding persisted at 30 days and 6 months.

Our analysis included a broader patient sample than previous studies, including nearly equal numbers of men and women, patients younger than 45 years to older than 75 years, and patients from a variety of hospital settings. We were able to adjust for disease severity and treatment in multivariate models, adding strength to the statement that African American patients in general do at least as well, if not better, than white patients admitted to the hospital with heart failure.

These data serve to challenge several preconceived presumptions. Our data demonstrate that when treated similarly with evidence-based therapy and with similar access to short-term treatment strategies, African American patients have better outcomes than white patients for yet unidentified reasons. Our data also suggest in a provocative way that evidence of inpatient disparate health care (ie, less good quality of care and subsequently poorer outcomes in African American patients with heart failure) is not present in the hospital course of these patients. One cannot assume that the hospitalized environment is the seat of disparate health care for African American patients with heart failure.

Given the lower in-hospital mortality rates in African American patients but the higher rates of hospitalization in African American patients compared with white patients, a more valid concern in African American patients with heart failure is disparate health care in the outpatient environment, with African American patients using emergency facilities more frequently and, thus, being admitted to the hospital more often for ADHF. Conversely, white patients may have greater access to outpatient care, including integrated disease management programs, and, thus, white patients may be sicker when admitted to the hospital. Our analysis finds that this is unlikely to explain the entire discrepancy. Similar or worse measures of disease severity were seen in African American patients with a higher frequency of ICU admission. Many studies, such as ours, that investigated disparities in inpatient health care use and quality have also found no racial differences, but a few studies have investigated differences in measures of heart failure quality of care outside the hospital, such as continued access to and compliance with long-term oral medication therapy.10-12,15,16 We believe this is an opportunity for future investigation.

These findings should be evaluated in the context of several limitations. We do not have data regarding the mode of death or the cause of the heart failure decompensation. We assume that mortality in most patients admitted with a primary diagnosis of heart failure is attributable to cardiac causes, but confirmatory data are unavailable. It is also unknown whether most cardiovascular deaths are attributable to sudden cardiac death or progressive pump failure, which is critical to understanding the natural history of both disease processes and determining directions for future therapy. Data were not collected regarding self-care, health literacy, or socioeconomic status; thus, assessments regarding disparities in outpatient care cannot be thoroughly evaluated. ADHERE is not a clinical trial database but a registry. As such, it has no treatment requirements, randomization, or longitudinal follow-up. Because no patient identifiers are collected, patients may be entered into the registry more than once. However, our subgroup analysis in patients with new-onset heart failure was consistent with the findings of the overall cohort, decreasing the likelihood that the overall results were influenced by multiple hospitalizations of the same patient. Patient status could not be followed up for long-term outcomes be-

### Table 4. Adjusted ORs for Mortality in Acute Decompensated Heart Failure by Race

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI) for Mortality, African American vs White Patients</th>
<th>P Value</th>
<th>Area Under the ROC Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patient episodes</td>
<td>model 1: 0.54 (0.43-0.69), model 2: 0.72 (0.56-0.93), model 3: 0.77 (0.57-0.96)</td>
<td>&lt;.001</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Abbreviations: CAD, coronary artery disease; CI, confidence interval; HF, heart failure; MI, myocardial infarction; OR, odds ratio; ROC, receiver operating characteristic.

The variables used in multivariate models are as follows: unadjusted (none missing); model 1, adjusted for age and sex (0.01% missing); model 2, variables included in model 1 plus dyspnea at rest, blood urea nitrogen level, creatinine level, initial systolic blood pressure, initial diastolic blood pressure, initial heart rate, and sodium level (2.9% missing); and model 3, variables included in model 2 plus long-term angiotensin-converting enzyme inhibitor or angiotensin receptor blocker and β-blocker use (2.9% missing).
cause no identifiers were collected. The data are observational, and the analysis is retrospective. In addition, the results may be influenced by assessment and treatment regimens that are not standardized at any institution. Individuals with preserved ejection fraction were included in the analyses and, thus, the assessment of long-term oral therapy for heart failure could be confounded.

In conclusion, in ADHF, African American race is associated with a different natural history but similar or better inpatient use of evidence-based therapy, shorter length of stay, and lower in-hospital mortality rates compared with white race, despite similar or worse indicators of disease severity in African American patients. In view of these findings, the focus on heart failure management for African American patients should be early surveillance and detection of heart failure and optimization of long-term medical and device therapy, including race-specific strategies, adequate follow-up, and, especially, improved access to outpatient care. In addition, these data in African American patients hospitalized with heart failure point out that issues related to disparate health care are complex and likely involve the entire treatment continuum and may, in fact, be less likely to implicate the inpatient setting.

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Author Contributions: Dr Yancy had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Fonarow and Yancy. Acquisition of data: Fonarow and Yancy. Analysis and interpretation of data: Kamath, Drazner, Wynne, Fonarow, and Yancy. Drafting of the manuscript: Kamath, Fonarow, and Yancy. Critical revision of the manuscript for important intellectual content: Kamath, Drazner, Wynne, and Fonarow. Statistical analysis: Wynne and Fonarow. Obtained funding: Fonarow. Administrative, technical, and material support: Fonarow. Study supervision: Fonarow and Yancy. Financial Disclosure: Ms Wynne is employed by Alza Corporation (previously Scios Inc).

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REFERENCES